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and an ionic conductance rate of at least 5.1 μmhos/min.

190 ~~191~~. The composite membrane of claim ~~189~~ 190, wherein the thickness of said composite membrane is in the range of between 0.06 and 0.8 mils.

191 ~~192~~. The composite membrane of claim ~~189~~ 190, wherein the thickness of said composite membrane is in the range of between about 0.5 and 0.8 mils.

192 ~~193~~. The composite membrane of claim ~~189~~ 190, wherein the thickness of said composite membrane is at most 0.5 mils.

193 ~~194~~. The composite membrane of claim ~~189~~ 190, wherein said at least one ion exchange resin comprises a mixture of ion exchange resins.

194 ~~195~~. The composite membrane of claim ~~189~~ 190, wherein said at least one ion exchange resin comprises a perfluorinated sulfonic acid resin.

195 ~~196~~. The composite membrane of claim ~~189~~ 190, wherein said at least one ion exchange resin comprises a perfluorinated carboxylic acid resin.

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196 ~~197~~. The composite membrane of claim ~~190~~ 189, wherein said at least one ion exchange resin comprises a polyvinyl alcohol.

197 ~~198~~. The composite membrane of claim ~~190~~ 189, wherein said at least one ion exchange resin comprises a divinyl benzene resin.

198 ~~199~~. The composite membrane of claim ~~190~~ 189, wherein said at least one ion exchange resin comprises a styrene-based polymer.

199 ~~200~~. The composite membrane of claim ~~190~~ 189, wherein said at least one ion exchange resin further comprises metal salts with or without a polymer.

200 ~~201~~. The composite membrane of claim ~~194~~ 193, wherein said mixture of ion exchange resins includes at least two of a perfluorinated sulfonic acid resin, a perfluorinated carboxylic acid resin, a polyvinyl alcohol resin, a divinyl benzene resin or a styrene-based polymer.

201 ~~202~~. The composite membrane of claim ~~194~~ 193, wherein said at least one ion exchange resin is a perfluorosulfonic acid/tetrafluoroethylene copolymer resin.

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202 ~~203~~. The composite membrane of claim 189, further comprising a reinforcement backing bonded to a side thereof.

203 ~~204~~. An integral substantially air occlusive integral composite membrane having a support with a microstructure of pores, said microstructure filled with an ion exchange resin, said composite membrane has an ionic conductance rate of at least 5.1 μmhos/min, said composite membrane prepared by,

(a) providing a support having a microstructure of micropores;

(b) sequentially applying an ion exchange resin solution to each major surface of said support; and

(c) repeating step (b) until said micropores are sufficiently filled with ion exchange resin to form an air occlusive integral composite membrane.

204 ~~205~~. The composite membrane of claim 203, wherein said step (b) further includes,

(b1) drying said support after each application of ion exchange resin solution to remove solvent from said solution.

205 ~~206~~. The composite membrane of claim 203, wherein said step (b) includes at least three successive applications of said ion exchange resin solution.

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206 ~~207~~. The composite membrane of claim 203 ~~204~~, wherein said step (b) includes at least four successive applications of said ion exchange resin solution.

207 ~~208~~. The composite membrane of claim 203 ~~204~~, wherein said step (b) includes at least three successive applications of said ion exchange resin solution, each followed by a drying step.

208 ~~209~~. The composite membrane of claim 203 ~~204~~, wherein said step (b) includes at least four successive applications of said ion exchange resin solution, each followed by a drying step.

209 ~~210~~. The composite membrane of claim 203 ~~204~~, having a thickness in the range between 0.06 and 0.8 mils.

210 ~~211~~. The composite membrane of claim 203 ~~204~~, having a thickness in the range of between about 0.5 and at most 0.8 mils.

211 ~~212~~. The composite membrane of claim 203 ~~204~~, having a thickness of at most about 0.5 mils.

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212 ~~213~~. The composite membrane of claim ~~204~~ 203, wherein said ion exchange resin is a mixture of resins.

213 ~~214~~. The composite membrane of claim ~~204~~ 203, wherein said ion exchange resin is a perfluorinated sulfonic acid resin.

214 ~~215~~. The composite membrane of claim ~~205~~ 204, wherein said drying is conducted at about room temperature.

215 ~~216~~. The composite membrane of claim ~~204~~ 203, wherein said ion exchange resin solution is applied in the presence of a surfactant.

216 ~~217~~. The composite membrane of claim ~~205~~ 204, wherein said ion exchange resin solution is applied in the presence of a surfactant.

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217 ~~218~~. A method of preparing a substantially air occlusive integral composite comprising:

(a) providing a support having a microstructure of micropores;

(b) sequentially applying an ion exchange resin solution to each major surface of said support; and

(c) repeating step (b) until said micropores are sufficiently filled with ion exchange resin to form an air occlusive integral composite membrane which has an ionic conductance rate of at least 5.1 μmhos/min.

218 ~~219~~. The method of claim ~~218~~ 217, wherein said step (b) includes at least three successive applications of said ion exchange resin solution.

219 ~~220~~. The method of claim ~~218~~ 217, wherein said step (b) includes at least four successive applications of said ion exchange resin solution.

220 ~~221~~. The method of claim ~~218~~ 217, wherein said step (b) includes at least two successive applications of said ion exchange resin solution, each followed by a drying step.

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221 222. The method of claim 217 218, wherein said step (b) includes at least three successive applications of said ion exchange resin solution, each followed by a drying step.

222 223. The method of claim 217 218, wherein said composite membrane has a thickness within the range of 0.06 to 0.8 mils.

223 224. The method of claim 217 218, wherein said composite membrane has a thickness within the range of 0.5 to 0.8 mils.

224 225. The method of claim 217 218, wherein said composite membrane has a thickness of at most 0.5 mils.

225 226. The method of claim 217 218, wherein said ion exchange resin is a mixture of resins.

226 226. The method of claim 217 218, wherein said ion exchange resin is a perfluorinated sulfonic acid resin.

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227. The method of claim ~~219~~ 218, wherein said at least three successive applications of said ion exchange solution include alternate applications of said resin solution to a first side of said support and then to a second side of said support.

228. A fuel cell including an ultra-thin, air impermeable integral composite membrane; said composite membrane comprising:

a support having a microstructure of micropores, said microstructure defining a porosity in the range of about 70% to 95% within said support,

at least one ion exchange resin filling said microstructure such that said composite membrane is air impermeable, said composite membrane having a thickness of at most 0.8 mils.

229. The fuel cell of claim 228, wherein said composite membrane has a thickness in the range of between 0.06 and at most 0.8 mils.

230. The fuel cell of claim 228, wherein said composite membrane has a thickness of at most 0.5 mils.

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231. The fuel cell of claim 228, wherein said at least one ion exchange resin comprises a mixture of ion exchange resins.

232. The fuel cell of claim 228, wherein said at least one ion exchange resin comprises a perfluorinated sulfonic acid resin.

233. The composite membrane of claim ~~190~~ 189, wherein the thickness of said composite membrane is at most 0.4 mils.

234. The composite membrane of claim ~~190~~ 189, wherein the thickness of said composite membrane is at most 0.3 mils.

235. The composite membrane of claim ~~190~~ 189, wherein the thickness of said composite membrane is at most 0.2 mils.

236. The composite membrane of claim ~~190~~ 189, wherein the thickness of said composite membrane is at most 0.1 mils.

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237. The composite membrane of claim ~~211~~ 210, wherein the thickness of said composite membrane is at most 0.4 mils.

238. The composite membrane of claim ~~211~~ 210, wherein the thickness of said composite membrane is at most 0.3 mils.

239. The composite membrane of claim ~~211~~ 210, wherein the thickness of said composite membrane is at most 0.2 mils.

240. The composite membrane of claim ~~211~~ 210, wherein the thickness of said composite membrane is at most 0.1 mils.

241. The composite membrane of claim ~~218~~ 217, wherein the thickness of said composite membrane is at most 0.4 mils.

242. The composite membrane of claim ~~218~~ 217, wherein the thickness of said composite membrane is at most 0.3 mils.

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243. The composite membrane of claim ~~218~~ 217, wherein the thickness of said composite membrane is at most 0.2 mils.

244. The composite membrane of claim ~~218~~ 217, wherein the thickness of said composite membrane is at most 0.1 mils.

245. The composite membrane of claim ~~204~~ 203, wherein the thickness of said composite membrane is at most 0.4 mils.

246. The composite membrane of claim ~~204~~ 203, wherein the thickness of said composite membrane is at most 0.3 mils.

247. The composite membrane of claim ~~204~~ 203, wherein the thickness of said composite membrane is at most 0.2 mils.

248. The composite membrane of claim ~~204~~ 203, wherein the thickness of said composite membrane is at most 0.1 mils.

249. An integral air impermeable composite membrane comprising:

a support having a microstructure of micropores, said microstructure defining a porosity in the range of about 70% to 98% within said support,

at least one ion exchange resin filling said microstructure such that said composite membrane is air impermeable, said composite membrane having a thickness of at most 0.8 mils.

30 250. The composite membrane of claim 29 249, wherein the thickness of said composite membrane is in the range of between 0.06 and 0.8 mils.

31 251. The composite membrane of claim 29 249, wherein the thickness of said composite membrane is in the range of between about 0.5 and 0.8 mils.

32 252. The composite membrane of claim 29 249, wherein the thickness of said composite membrane is at most 0.5 mils.

33 253. The composite membrane of claim 29 249, wherein said at least one ion exchange resin comprises a mixture of ion exchange resins.